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14. ABSTRACT
The modern household can be a chaotic place, full of noise from radios, televisions, family members. The ability to separate speech from background noise is a critical skill for understanding spoken language in such environments. Recent studies suggest that adults with Autism Spectrum Disorders have particular difficulty recognizing speech in acoustically-hostile environments (e.g., Alcantara et al. 2004), but an underlying cause for this deficit remains unknown. This proposal tests our hypotheses that children with ASD will find it more difficult to separate the speech of different talkers than do their typically-developing peers. We also predict that they will fail to exploit visual cues on a talker's face to help in this task, further limiting their ability to process input and learn language on a typical schedule. To date, the data do not seem to match our predictions: children with ASD and typical children appear better able to recognize speech in quiet than in noise, and show better recognition when they can see the face of the person instructing them vs. when there is no visual speech information present. However, the data collection is not yet complete, particularly for children with ASD.

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INTRODUCTION:

   Much of the language input that children receive occurs in the presence of background noise, including noise from other talkers (Barker & Newman, 2004; van de Weijer, 1998). Studies suggest that adults with Autism Spectrum Disorders (ASD) may have particular difficulty recognizing speech in these types of acoustically-hostile environments (e.g., Alcántara, Weisblatt, Moore, & Bolton, 2004), but an underlying cause for this deficit remains unknown. If children with ASD are likewise less adept at separating speech from distractors, they may be unable to learn language from many settings in which children are typically placed. In addition, one of the cues that typically-developing listeners use to help separate streams of speech is coordinated visual information from a talker's face, but children with autism have been reported to show abnormal visual processing for facial information (e.g. Klin et al., 1999; Wolf et al., 2008) and atypical visual scan patterns of faces (e.g., Klin, Jones, Schultz, Volkmar, & Cohen, 2002), and adults with autism have been shown to have difficulty using facial information to assist them in interpreting speech in difficult listening environments (Smith & Bennetto, 2007). The current proposal compares children with autism spectrum disorders (ASD) to typically-developing chronologically age-matched (CA) and mental-age matched (MA) peers on the ability to understand speech that occurs in the presence of background noise (a distractor voice). We also examine their ability to exploit visual cues to assist in listening in noise, by testing the groups' speech recognition both when a face is visible and when it is not. We hypothesize that children with ASD will find both these tasks more difficult than will typically-developing children. Knowing whether toddlers with ASD have difficulties processing speech in the presence of acoustic distraction has the potential to greatly inform our understanding of the causes of language delay/disorder in this population, and will have vital implications for child-care and interventional practices (e.g., noise levels in home- and center-based treatment settings, &/or employing methods of enhancing the signal).

BODY:

Our original proposal was for a 2-year project; however, we have requested a no-cost extension. The approved Statement of Work listed 6 tasks; below we describe each task in our statement of work, and where we stand with regards to its completion.

Task 1, human subjects approval, months 1-4
The beginning portion of the grant proposal was geared towards developing the necessary consent forms and recruitment documents for this proposal, and obtaining regulatory approval. This task was completed during this first year of the proposal.

Task 2, stimulus development, months 2-4
Our next task was to create the video and audio stimuli necessary for this experiment. This was originally completed in the first few months of the proposal, although pilot testing suggested that some of our stimuli needed alterations to maintain the attention of younger participants and those with ASD. Those stimulus changes were likewise completed during the first year of the proposal.

Task 3, ADOS training & reliability, months 1-5
As part of this study, we need to ensure that the children in our experimental group do indeed have a diagnosis on the autism spectrum. Although our department includes several clinical faculty with significant experience working with this population, none had previously had research training in conducting ADOS assessments. Thus our third task involved sending one grant staff member to receive training in these assessments, and conduct reliability measures so that we would be able to perform ADOS assessments for our participants. Although this process took longer than expected (see annual report last year), we now have three individuals on this project who are certified to provide ADOS assessments, and are caught up on providing ADOS testing for our participants.

Task 4, recruitment, months 5-20
Task 5, testing participants, months 6-24
Task 6, coding and analysis (coding of primary experiment will be complete by month 24; coding of secondary parent-child interactions is expected to continue beyond the end of the granting period).
        These three tasks are ones that we had expected to have begun in the first year of the grant process, and to have completed by the end of the second year.   Although we did begin recruiting children with Autism in year 1, the process of recruitment has gone more slowly than expected, such that we are not yet completely finished. This led to our request for a no-cost extension.
        More specifically, we have been actively recruiting children with Autism, including attending the Autism Speaks walks in Washington, D.C. each year; we have created posters and brochures for recruitment, and have been distributing these posters at various locations in the community; we have trained laboratory personnel to conduct the various aspects of this study, including testing participants in the primary study, testing children on the Mullen Scales of Early Learning, setting up and recording a parent-child interaction, coding looking behavior, and coding clinical assessments. We also have students trained to code the secondary parent-child interactions, and have begun the process of doing so.
        Our original plan had been to test 20 children with autism, 20 typically-developing children matched for chronological age, and 20 typically-developing children matched for mental age; the latter would require testing additional children, since we could not know the mental age of any given child (and thus whether they could serve as a match) until we had tested them.

To date we have tested 16 children with autism (13 in the past 12 months), and 45 control participants. All have been coded for the primary experiment; most have been coded for a second coder for reliability. Unfortunately, several children who participated as part of the experimental (autism) group did not meet criteria for ASD on the ADOS, despite having had an earlier diagnosis; as a result, data from only 12 of the 16 children with autism are usable. We have age-matched control children for 10 of the 12, and are working on recruiting age-matches for the others. We have another family with a child with autism who is potentially interested and with whom we are currently working to schedule a session.

Although we have not tested as many children with autism as we would have liked by this point in the project, we note that of the 16 children tested, 13 were tested during the past 12 months; thus, we feel we can reach our goal of 20 participants with autism by the end of the 1-year no-cost extension period.

KEY RESEARCH ACCOMPLISHMENTS:

Our key accomplishments have been:

- Finalization of, and approval of, plan for testing
- Creation and pilot testing of all stimuli/research design
- Training of relevant staff on the project
- Testing of initial over 60 participants to date, ensuring adequate procedures for testing and coding.
- We confirmed our *a priori* hypotheses in the TD children, of whom we have a much larger sample. This is partially a replication of previous work but also adds a novel component with the addition of the speaker's face as a visual cue.
- In the past year, we tested 13 children with autism and 27 control participants (40 participants total).
- We have submitted an abstract to present data at the IMFAR conference for 2015.

REPORTABLE OUTCOMES:

We do not yet have any reportable outcomes. However, data analyzed to date suggests that while children with autism were showing poorer performance than neurotypical controls in general, they were still able to succeed at the task overall. Averaging across conditions, both groups of children looked proportionally more towards the target than distractor object, suggesting that they understood the task (neurotypical: $t(12) = 12.65$, $p < 0.0001$, ASD: $t(10) = 2.11$, $p = 0.06$). However, for children with ASD, the only condition with significantly longer looking to the target than distractor was *face quiet* ($t(10) = 2.73$, $p = 0.02$). In contrast, neurotypical children showed a significant difference in looking time to the target vs. distractor in all four conditions ($ps < 0.001$). Neurotypical children performed better than children with ASD (i.e., looked significantly more towards the target) on both *face quiet* and *blank quiet* ($ps < 0.05$) trials, with *face noise* approaching significance ($p = 0.06$). Thus preliminary results suggest that children with ASD are most successful comprehending language in quiet environments when given both visual and auditory information. Children with ASD and control children appear to be affected in a similar way by background noise.

CONCLUSION:

Over the past year we have been actively recruiting both children with autism and control participants for our project. We expect to complete testing over the course of the upcoming 12 months, at which point we will be in a better position to interpret our findings. However, results to date suggest that while children with ASD perform more poorly than children with ASD, they are affected by noise in a similar manner qualitatively as are neurotypical children.

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